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STATE COMMITTEE FOR INVENTIONS AND DISCOVERIES

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ABSTRACT OF INVENTION FOR A USSR CERTIFICATE OF RECOGNITION

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(54) Method of Testing Hydraulic Units

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(54) METHOD OF TESTING HYDRAULIC UNITS

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The present invention is a method of testing the performance of constant displacement hydraulic units. The goal of the invention is to expand the functional abilities of a unit by applying this test method to transient temperature conditions. The method consists of the following: heating the hydraulic fluid to the highest permissible temperature, pumping it to the unit previously cooled to the lowest permissible temperature of the environment, and putting the unit to work in accordance with test conditions until the temperature of the hydraulic unit's external surface stabilizes.

2 illustrations.

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(71) The Institute of Issues Related to Machinery Reliability and Durability of the BSSR Academy of Sciences
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(53) 62-82.001.4 (083.74)
(56) All-Union State Standard 20245-71. Testing Hydraulic Equipment. Moscow, Standards Publishing House, 1982, page 12, paragraph 2.2.1.3.

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2 illustrations.

The present invention is relative to mechanical engineering, specifically to methods of testing the performance of constant displacement hydraulic units, and particularly hydraulic actuators functioning under conditions of considerable temperature disparity between the environment and the hydraulic fluid in a hydraulic actuator circuit.

The goal of the present invention is to expand functional abilities of a unit by applying the test method to transient thermal behavior of actuated and non-rotational parts in a hydraulic actuator.

Figure 1 represents a diagram of a devise used for testing the performance of a hydraulic distributor under conditions of temperature disparity between the environment and the hydraulic actuator circuit. Figure 2 represents a fragment of a hydraulic distributor and the tolerance between the surfaces for a sealing gap (clearance).

The method consists of the following: a hydraulic unit operating at the lowest exterior temperature permissible for its proper functioning for a given hydraulic fluid, is pumped with fluid heated to the highest temperature permissible for a given hydraulic actuator circuit. Simultaneously, the hydraulic unit is being put to work in accordance with test conditions, and the moment when the temperature of the unit's external surface stabilizes is registered experimentally.

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The hydraulic fluid flowing through the unit's circuit, causes the parts to heat up and distort. Actuated parts, due to their lower mass, heat up and change in size more quickly than external non-rotational parts having a higher mass. As a result, during the transient, the duration of which is defined by the moment when the temperature of the external part stabilizes, clearances are modified in such a way that the size of the male part increases to a greater degree than the size of the female part. If the tolerance between the sealing elements forming sealing contact is unfavorable, there is a high possibility of the surfaces gripping or rubbing against each other, or other damages.

If the testing of a hydraulic unit based on the present method proves successful, the unit can be guaranteed to be reliable in terms of rubbing of the working surfaces, regardless of temperature combinations between the environment and the hydraulic actuator circuit, provided they fall within the range of permissible values.

The devise for testing the present method (see Fig. 1) consists of the following: a pump (1), a pressure-relief valve (2), directional control valves (3 and 4), a heat chamber (5) with the hydraulic distributor under test (6), two more pressure-relief valves (7 and 8), a tank (9), a thermo-contact thermometer (10), and a heater (11). The directional control valves (3 and 4) and the distributor (6) are controlled by pushing electromagnets.

The distributor under test (see Fig. 2) consists of a housing (12) with fluid supply and return openings (13), and a pilot hole (14) containing a slide valve (15) with a bearing surface (16). The mobility of the slide valve (15) is ensured by means of a guaranteed clearance between surfaces (14) and (16), where the size of the clearance is defined by the range (17) of tolerance of the opening (14) in the housing (12), and the range (18) of tolerance of the slide valve's (15) bearing surface (16) diameter. The size of guaranteed clearance can vary from the minimum to the maximum value; it is random in any given distributor and can have any value within the above stated range.

The devise for testing the present method operates in the following way:

The heater (11) and the pump (1) are turned on. The hydraulic fluid is forced by the pump through a directional control valve (3) to the tank (9), where it is mixed and evenly heated to the temperature equaling the highest level permissible for the hydraulic actuator circuit of the distributor under test (6). As soon as the temperature reaches the above mentioned mark, the thermo-contact thermometer (10) cuts off the energy supply to the heater (11). At that point, the electromagnet of the directional control valve (3) is switched on. The flow of the fluid is directed through directional control valve (4) to the distributor (6), and then through valves (7) and (8) maintaining pressure in the system, to the tank.

Since the electromagnets of the distributor (6) are alternately switched on and off, the pressure administered to one of the channels first equals a level defined by valve (7) and then a level defined by valve (8). When the electromagnet of the

directional control valve (4) is switched on, a change of loading in the channels of the distributor (6) occurs.

When hydraulic fluid is pumped through the channel (13) (see Fig. 2) in the housing (12) to the slide valve (15), it causes the temperature of both the slide valve (15) and the housing (12) to increase. Due to the difference in masses and the conditions of reciprocal heat transfer between the fluid and the surfaces it comes in contact with, the latter heat up with a different intensity, and, as a result, the deformation of the slide valve surface (16) occurs faster than the deformation of the opening surface (14) in the housing (12). Consequently, the clearance between these two surfaces, which is defined by a random proportion of tolerance (17 and 18) between surfaces (14) and (16) accordingly, decreases.

A distributor that passes the test in accordance with the method discussed here, is guaranteed against operational failures (such as jamming of rubbing parts) at any random temperature combination between the environment and the hydraulic circuit, provided the said temperatures have the following values: the temperature of the environment is higher or equals the lowest permissible temperature, and the temperature of the flowing fluid is lower or equals the highest temperature permissible for a given hydraulic actuator circuit.

Invention Formula

The present method of testing the performance of a constant displacement hydraulic unit, consisting in heating hydraulic fluid to the highest temperature permissible for a given hydraulic actuator circuit, pumping it to the unit tank and simultaneously putting the unit to work in accordance with the test conditions, is exceptional, its uniqueness being the fact that in order to expand functional capabilities of the unit through extending the method to the transient thermal behavior of interacting actuated and non-rotational parts of a hydraulic unit under test, it is cooled to the lowest temperature of the environment permissible for it to operate with a given hydraulic fluid, and the loading continues until the exterior temperature of the hydraulic actuator stabilizes.

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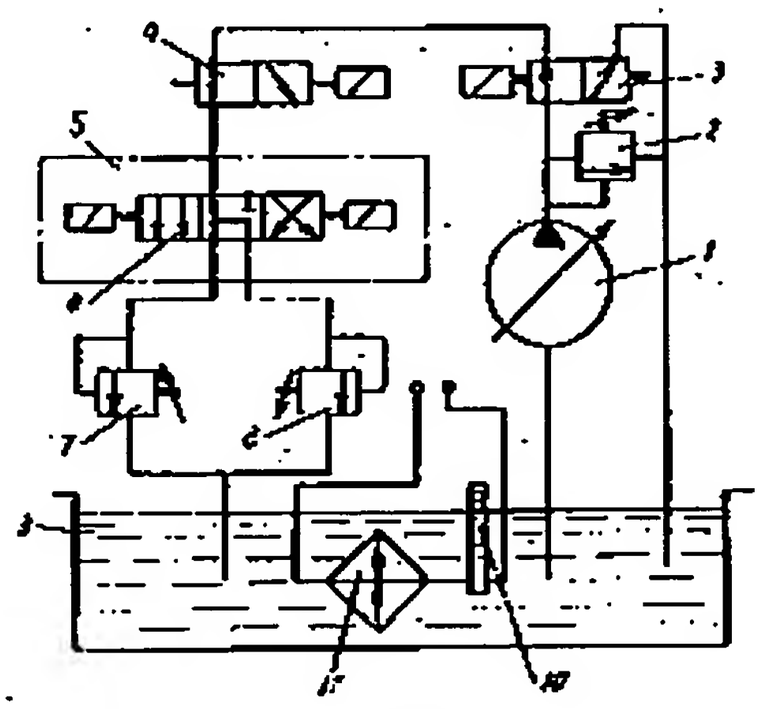

Fig. 1

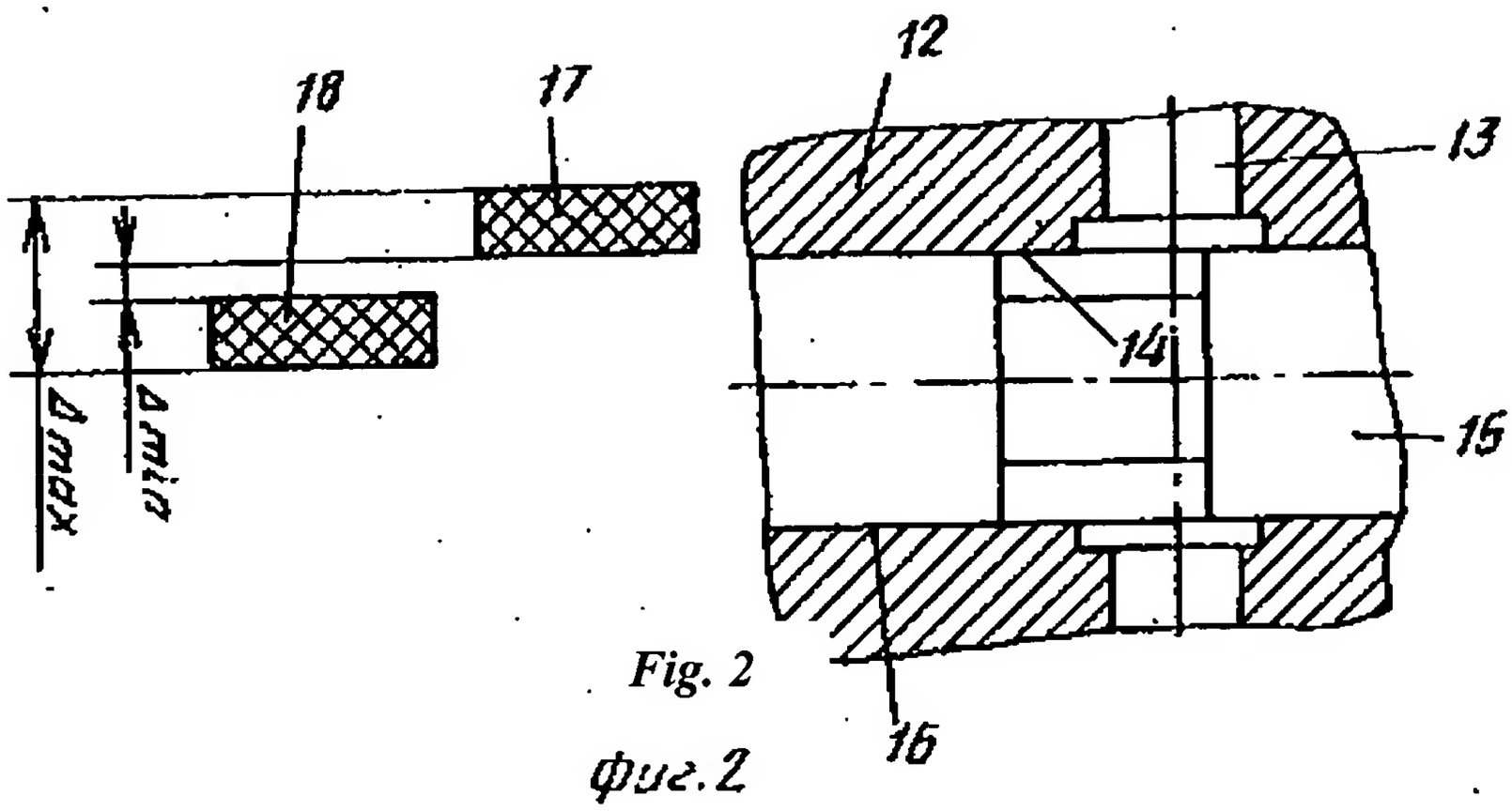

Fig. 2

Фиг. 2